

PATENT ABSTRACTS OF JAPAN

(11)Publication number : 07-213997

(43)Date of publication of application : 15.08.1995

(51)Int.Cl. B06B 1/06

G10K 9/122

H01L 41/09

H04Q 7/14

H04R 17/00

(21)Application number : 06-037838 (71)Applicant : HOKURIKU ELECTRIC IND
CO LTD

(22)Date of filing : 09.02.1994 (72)Inventor : NISHIYAMA SHOZO
SHINTANI TETSUYA

(54) PIEZOELECTRIC VIBRATOR

(57)Abstract:

PURPOSE: To provide a piezoelectric vibrator which has a simple structure, can be thinned easily, can obtain strong vibration, and is improved in the transmission efficiency of vibration.

CONSTITUTION: This apparatus is equipped with a piezoelectric vibrator of a bimorph element consisting of a plane diaphragm 12 and a piezoelectric body 14 which is stuck on the surface of the diaphragm 12. A case 18 of a resin or a metal which holds the piezoelectric vibrator and a vibration transmission member comprising a column or a support frame 16 with one end connected with the case 18 which is installed by

connecting the other end with the piezoelectric vibrator are installed. A vibration decreasing member consisting of a lap which decreases the frequency of the piezoelectric vibrator to an audible range and an elastic member is installed.

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CLAIMS

[Claim(s)]

[Claim 1]A piezoelectric vibration device comprising:

A piezoelectric transducer which consists of a plate-like diaphragm and a piezo electric crystal stuck on the surface.

A case which accommodated this piezoelectric transducer.

A vibration transmitting member which one end connected with this piezoelectric transducer, it was attached, and the other end connected to the above-mentioned case.

An oscillating successive diminution member which drops pitch of the above-mentioned piezoelectric transducer and is vibrated on frequency lower than a audio range.

[Claim 2]The piezoelectric vibration device according to claim 1 which is the buck which the above-mentioned vibration transmitting member held an edge part of the above-mentioned piezoelectric transducer, and an end connected to the above-mentioned case.

[Claim 3]The piezoelectric vibration device according to claim 1 or 2 which is the weight with which the above-mentioned oscillating successive diminution member was attached to the above-mentioned diaphragm.

[Claim 4]The piezoelectric vibration device according to claim 1 or 2 which is the elastic member by which the above-mentioned oscillating successive diminution member was attached to the above-mentioned diaphragm.

[Claim 5]The piezoelectric vibration device according to claim 1 which provided the above-mentioned vibration transmitting member in a center section of the above-mentioned piezoelectric transducer, and attached to an edge part of the above-mentioned piezoelectric transducer a buck which served as weight.

[Claim 6]The piezoelectric vibration device according to claim 1 which provided an elastic member which served both as the above-mentioned oscillating successive diminution member and a vibration transmitting member in a center section of the above-mentioned piezoelectric transducer, and attached to an edge part of the above-mentioned piezoelectric transducer a buck located in midair to serve also as weight.

[Claim 7]The piezoelectric vibration device according to claim 1 with which the above-mentioned piezoelectric transducer consists of bimorph elements.

[Claim 8]The piezoelectric vibration device according to claim 1, 4, 5, or 6 whose above-mentioned elastic member is a metallic spring.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Industrial Application]Using a piezoelectric transducer, this invention generates vibration of a low frequency wave, and relates to the piezoelectric vibration device used as an informing device of portable communication equipment, such as a cellular phone and a pager.

[0002]

[Description of the Prior Art]The conventional piezoelectric vibration device connected the relay member to one field of this piezoelectric element using the piezoelectric element of a lamination type, and was this thing that relay-part-material-**, connects with a diaphragm, and generates vibration as indicated by JP,4-292025,A, for example. And this piezoelectric element was vibrated on frequency lower than a audio range, vibration was transmitted to the diaphragm via the relay member, and it has reported to the user.

[0003]

[Problem(s) to be Solved by the Invention]the above -- in the case of a Prior art, since the laminated type piezoelectric element is used, structure becomes complicated, and it cannot slim down. A relay member is connected to one field of a piezoelectric element, vibration is transmitted to the diaphragm, and vibration cannot be told outside efficiently.

[0004]this invention -- the above -- it accomplished in view of the Prior art, and it is

easy composition, slimming down is easy, a strong vibration is obtained, and the transmission efficiency of vibration is also aimed at providing a good piezoelectric vibration device.

[0005]

[Means for Solving the Problem]A piezoelectric vibration device this invention is characterized by that comprises the following.

A piezoelectric transducer of a bimorph element which consists of a plate-like diaphragm and a piezo electric crystal stuck on the surface, or a uni-morph element. Resin or the metal cases where this piezoelectric transducer was accommodated.

Vibration transmitting members, such as a support or a buck which one end connected with this piezoelectric transducer, it was attached, and the other end connected to the above-mentioned case.

The above-mentioned vibration transmitting member is the buck which held an edge part of the above-mentioned piezoelectric transducer, and an end connected to the above-mentioned case. An oscillating successive diminution member which becomes the above-mentioned piezoelectric transducer from elastic members, such as weights, such as resin and metal, or a metallic spring, is attached.

[0006]This invention is the piezoelectric vibration device which provided the above-mentioned vibration transmitting member in a center section of the above-mentioned piezoelectric transducer, and attached to an edge part of the above-mentioned piezoelectric transducer a buck which served as weight. A center section of the above-mentioned piezoelectric transducer is pinched by a support, an elastic member and a support, a support or an elastic member, and elastic member.

[0007]

[Function]Since vibration is made to be transmitted to a case at the piezoelectric transducer in which the piezo electric crystal was stuck on the diaphragm via a support, and a buck or an elastic member, as for the piezoelectric vibration device of this invention, vibration of a piezoelectric transducer is transmitted to a case efficiently and certainly. While vibration of a piezoelectric transducer is changed into vibration of a desired low frequency wave, amplitude is increased by the oscillating successive diminution member which consists of an elastic member or weight, and a stronger vibration is transmitted to a case by it.

[0008]

[Example]The example of this invention is described based on a drawing below. Drawing 1 – drawing 7 show the first example of this invention, and the piezoelectric vibration device 10 of this example is provided with the piezoelectric transducer 15 which is a bimorph element by which the piezo electric crystals 14, such as electrostrictive ceramics, were stuck on the surface and rear surface of the metal diaphragms 12 as shown in drawing 1. In the field of the outside of each piezo electric crystal 14, the electrode was formed and, as for the electrode of another side, the

diaphragm 12 serves as while not illustrating. The buck 16 made of resin is formed in the edge part of the piezoelectric transducer 15 over the perimeter, and this buck 16 is being fixed to the case 18.

[0009]As shown in drawing 2, the weight 20 which becomes a center section of the piezoelectric transducer 15 from an insulator or sheet metals, such as resin, is being fixed to this piezoelectric vibration device by adhesives, such as an epoxy resin. This weight 20 amplifies the amplitude of vibration while decreasing successively the pitch in the simple substance of the piezoelectric transducer 15 to the low frequency wave of a request lower than a audio range, for example, 100–200 Hz. This weight 20 may be directly fixed to the piezo electric crystal 14 of the piezoelectric transducer 15 via the spacers 22, such as resin, as shown in drawing 3. As shown in drawing 4, the weight 20 may be attached to the piezo electric crystal 14 of both sides of the piezoelectric transducer 15 via the spacer 22. As shown in drawing 5, without passing the spacer 22, the weight 20 may be directly fixed to the piezo electric crystal 14 of both sides of the piezoelectric transducer 15, and as shown in drawing 6 and drawing 7, the spacer 22 and the weights 20, such as resin formed in one, may be fixed to both sides or one side of the piezoelectric transducer 15.

[0010]While supporting the piezoelectric transducer 15 which consists of bimorph elements by the support member 16 according to the piezoelectric vibration device of this example, Since the weight 20 was attached to the center section of the piezoelectric transducer 15, vibration of the piezoelectric transducer 15 is transmitted directly efficiently in the case 18, and it can be made a moreover very thin structure. While dropping pitch on desired frequency easily by having attached weight to the center section of the piezoelectric transducer 15, amplitude can be increased and vibration can be certainly transmitted to a user by strong vibration. As shown in drawing 5, it can slim down further by fixing the weight 20 to the piezoelectric transducer 15 directly.

[0011]The piezoelectric vibration device of the second example of this following invention is explained based on drawing 8 and drawing 9. The member same here as an above-mentioned example attaches identical codes, and omits explanation. The piezoelectric vibration device of this example connects the supports 24, such as resin in which the end was supported by the case 18, to the center section of the piezoelectric transducer 15. The piezoelectric vibration device 10 shown in drawing 8 connects the support 24 to both sides of the piezoelectric transducer 15, and the other end of the support 24 connects it to the case 18 respectively. And it is in the state where the buck 16 of the edge part of the piezoelectric transducer 15 was attached to the diaphragm 12, and it was located in midair and frequency successive diminution and an amplitude increase function are achieved as the weight 20. What is shown in drawing 9 formed the support 24 in one piezoelectric transducer 15 side, and the buck 16 has connected it to the case 18 by the another side side.

[0012] Since the piezoelectric vibration device of this example attached the support 24 to the center section of the piezoelectric transducer 15, vibration is transmitted with each certainly sufficient efficiency to the case 18. As shown in drawing 8, both sides of the case 18 can be vibrated in a similar manner by pinching and holding the piezoelectric transducer 15 with the support 24. As shown in drawing 9, one side of the case 18 can be effectively vibrated by attaching the support 24 to one side of the piezoelectric transducer 15.

[0013] The piezoelectric vibration device of the third example of this following invention is explained based on drawing 10, drawing 11, and drawing 12. The member same here as an above-mentioned example attaches identical codes, and omits explanation. The piezoelectric vibration device of this example is supported with the metallic springs 26, such as metal flat springs and a coil spring, by using the center section of the piezoelectric transducer 15 as an elastic member, as shown in drawing 10. The other end of the metallic spring 26 was connected to the case 18, and the buck 16 formed in the edge part of the piezoelectric transducer 15 is connected to the near case 18 of another side as a support member. As shown in drawing 11, the piezoelectric transducer 15 may be pinched in the case 18 with the supports 24, such as resin in which the end was supported, and the metallic spring 26, it may hold in it, and the buck 16 functions on it as the weight 20 in this case. As shown in drawing 12, the piezoelectric transducer 15 may be pinched with the metallic spring 26 of a couple, and may be held. Also in this case, the buck 16 is functioning as the weight 20.

[0014] Since the piezoelectric vibration device of this example attached the metallic spring 26 to the center section of the piezoelectric transducer 15, while vibration is decreased successively efficiently, amplitude increases effectively and a strong, directly efficient vibration is transmitted to the case 18. By attaching the metallic spring 26 to one side of the piezoelectric transducer 15, as shown in drawing 10, one side of the case 18 -- effective -- oscillating **** -- as things are made and it is shown in drawing 11, vibration of the direction linked to the metallic spring 26 of the case 18 can be lessened by holding one piezoelectric transducer 15 side with the support 24, and supporting another side with the metallic spring 26. As shown in drawing 12, when both sides are supported with the metallic spring 26, both sides can be vibrated similarly.

[0015] The piezoelectric vibration device of the fourth example of this following invention is explained based on drawing 13 and drawing 14. The member same here as an above-mentioned example attaches identical codes, and omits explanation. The piezoelectric vibration device of this example supports one center-section side of the piezoelectric transducer 15, locates the piezoelectric transducer 15 in midair, and operates the buck 16 as the weight 20. What is shown in drawing 13 supports the piezoelectric transducer 15 with the support 24 as a support member and a vibration transmitting member. What is shown in drawing 14 supports the piezoelectric

transducer 15 with the metallic springs 26, such as metal flat springs and a coil spring, as a support member, a vibration transmitting member, and an elastic member.

[0016] Since the piezoelectric vibration device of this example connected the support 24 or the metallic spring 26 which the end connected to the case 18 to the center section of the piezoelectric transducer 15, vibration is efficient and vibration is transmitted to the case 18. The buck 16 of the edge part of the piezoelectric transducer 15 functions as the weight 20, while decreasing vibration of the piezoelectric transducer 15 successively efficiently, amplitude is increased, and vibration is directly transmitted to the case 18 efficiently. As shown in drawing 13, the near case 18 which the other end of the support 24 connected can be efficiently vibrated by connecting the support 24 to the center section of the piezoelectric transducer 15. As shown in drawing 14, the direction linked to the metallic spring 26 of the case 18 can be comparatively vibrated with big amplitude by a low frequency wave by supporting the support 24 only with the metallic spring 26.

[0017] The piezoelectric vibration device of the fifth example of this following invention is explained based on drawing 15 and drawing 16. The member same here as an above-mentioned example attaches identical codes, and omits explanation. The piezoelectric vibration device of this example supports one near center section of the piezoelectric transducer 15 with the support 24 or the metallic spring 26, and supports it with the metallic springs 30 which connected the another side side of the piezoelectric transducer 15 to the backing plate 28 fixed to the buck 16, and this backing plate 28, such as a flat spring and a coil spring. And the other end of the metallic spring 30 is connected to the case 18. What is shown in drawing 15 supports the center section of the piezoelectric transducer 15 with the support 24. What is shown in drawing 16 supports the center section of the piezoelectric transducer 15 with the metallic spring 26.

[0018] With the piezoelectric vibration device of this example as well as the third example of the above, vibration can be effectively transmitted to the case 18.

[0019] The piezoelectric vibration device of the sixth example of this following invention is explained based on drawing 17. The member same here as an above-mentioned example attaches identical codes, and omits explanation. The piezoelectric vibration device of this example forms the diaphragm 32 of the piezoelectric transducer 15 by insulating resin etc. And the metallic foil 34 is stuck on both sides of the diaphragm 32. And the piezoelectric vibration device of this example can also be used for the piezoelectric vibration device of the above-mentioned first thru/or the fifth example.

[0020] Since the piezoelectric vibration device of this example forms the diaphragm 32 with resin, it can obtain big amplitude on lower frequency. The diaphragm 32 can also be formed in the buck 16 and one, and insert molding of the metallic foil 34 can also be carried out in that case.

[0021]The piezoelectric vibration device of the seventh example of this following invention is explained based on drawing 18, drawing 19, and drawing 20. The member same here as an above-mentioned example attaches identical codes, and omits explanation. The piezoelectric vibration device of this example attaches the weight 20 to the buck 16 of the piezoelectric transducer 15 further at one. And the piezoelectric vibration device of this example can also be used for the piezoelectric vibration device of the above-mentioned first thru/or the fifth example.

[0022]The piezoelectric vibration device of this example can form the weight 20 in the buck 16 and one, and can form it also by methods, such as 2 color shaping.

[0023]A uni-morph element may be sufficient as the piezoelectric transducer of the piezoelectric vibration device of this invention, and it should just make a piezoelectric element produce field vibration. The elastic member of the piezoelectric vibration device of this invention is a thing that it may be a coil spring by metal resin, product made of resin, or metal besides a metallic spring, and other springs or hard rubber of shape should just be the elastic members which cannot absorb vibration easily. The support itself may function as an elastic member slightly. And the construction material of a support may also be ceramics and metal besides resin.

[0024]

[Effect of the Invention]The piezoelectric vibration device of this invention can transmit vibration of a piezoelectric transducer to a case efficiently, and, moreover, the strong vibration also with large amplitude is obtained. Therefore, a user can detect a signal by vibration certainly.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1]It is drawing of longitudinal section (A) and the top view (B) of a piezoelectric transducer of this invention. [of the first example]

[Drawing 2]It is drawing of longitudinal section showing the piezoelectric vibration device of the first example of this invention.

[Drawing 3]It is drawing of longitudinal section showing the modification of the piezoelectric vibration device of the first example of this invention.

[Drawing 4]It is drawing of longitudinal section showing the modification of the piezoelectric vibration device of the first example of this invention.

[Drawing 5]It is drawing of longitudinal section showing the modification of the piezoelectric vibration device of the first example of this invention.

[Drawing 6]It is drawing of longitudinal section showing the modification of the piezoelectric vibration device of the first example of this invention.

[Drawing 7]It is drawing of longitudinal section showing the modification of the piezoelectric vibration device of the first example of this invention.

[Drawing 8]It is drawing of longitudinal section showing the piezoelectric vibration device of the second example of this invention.

[Drawing 9]It is drawing of longitudinal section showing the modification of the piezoelectric vibration device of the second example of this invention.

[Drawing 10]It is drawing of longitudinal section showing the piezoelectric vibration device of the third example of this invention.

[Drawing 11]It is drawing of longitudinal section showing the modification of the piezoelectric vibration device of the third example of this invention.

[Drawing 12]It is drawing of longitudinal section showing the modification of the piezoelectric vibration device of the third example of this invention.

[Drawing 13]It is drawing of longitudinal section showing the piezoelectric vibration device of the fourth example of this invention.

[Drawing 14]It is drawing of longitudinal section showing the modification of the piezoelectric vibration device of the fourth example of this invention.

[Drawing 15]It is drawing of longitudinal section showing the piezoelectric vibration device of the fifth example of this invention.

[Drawing 16]It is drawing of longitudinal section showing the modification of the piezoelectric vibration device of the fifth example of this invention.

[Drawing 17]It is drawing of longitudinal section showing the piezoelectric vibration device of the sixth example of this invention.

[Drawing 18]It is drawing of longitudinal section showing the piezoelectric vibration device of the seventh example of this invention.

[Drawing 19]It is drawing of longitudinal section showing the modification of the piezoelectric vibration device of the seventh example of this invention.

[Drawing 20]It is drawing of longitudinal section showing the modification of the piezoelectric vibration device of the seventh example of this invention.

[Description of Notations]

10 Piezoelectric vibration device

12 and 32 Diaphragm

14 Piezo electric crystal

15 Piezoelectric transducer

16 Buck

18 Case

20 Weight

24 Support (support member)

26, 30 metallic springs (elastic member)

above-mentioned piezoelectric transducer and is vibrated on frequency lower than a audio range.

[Claim 2]The piezoelectric vibration device according to claim 1 which is the buck which the above-mentioned vibration transmitting member held an edge part of the above-mentioned piezoelectric transducer and an end connected to the above-mentioned case.
[Claim 3]The piezoelectric vibration device according to claim 1 or 2 which is the weight with which the above-mentioned oscillating successive diminution member was attached to the above-mentioned diaphragm.
[Claim 4]The piezoelectric vibration device according to claim 1 or 2 which is the elastic member by which the above-mentioned oscillating successive diminution member was attached to the above-mentioned diaphragm.
[Claim 5]The piezoelectric vibration device according to claim 1 which provided the above-mentioned vibration transmitting member in a center section of the above-mentioned piezoelectric transducer and attached to an edge part of the above-mentioned piezoelectric transducer a buck which served as weight.
[Claim 6]The piezoelectric vibration device according to claim 1 which provided an elastic member which served both as the above-mentioned oscillating successive diminution member and a vibration transmitting member in a center section of the above-mentioned piezoelectric transducer and attached to an edge part of the above-mentioned piezoelectric transducer a buck located in midair to serve also as weight.
[Claim 7]The piezoelectric vibration device according to claim 1 with which the above-mentioned piezoelectric transducer consists of bimorph elements.
[Claim 8]The piezoelectric vibration device according to claim 145 or 6 whose above-mentioned elastic member is a metallic spring.
</SDO>
<HR>DETAILED DESCRIPTION<HR><SDO DEJ><TXF FR=0002 HE=110 WI=080 LX=0200 LY=1700>[Detailed Description of the Invention]
[0001]
[Industrial Application]Using a piezoelectric transducer this invention generates vibration of a low frequency wave and relates to the piezoelectric vibration device used as an informing device of portable communication equipments such as a cellular phone and a pager.
[0002]
[Description of the Prior Art]The conventional piezoelectric vibration device connected the relay member to one field of this piezoelectric element using the piezoelectric element of a lamination type and was this thing that relay-part-material-**connects with a diaphragm and generates vibration as indicated by JP4-292025A for example. And this piezoelectric element was vibrated on frequency lower than a audio range vibration was transmitted to the diaphragm via the relay member and it has reported to the user.
[0003]
[Problem(s) to be solved by the Invention]the above -- in the case of a Prior art since the laminated type piezoelectric element is used structure becomes complicated and it cannot slim down. A relay member is connected to one field of a piezoelectric element vibration is transmitted to the diaphragm and vibration cannot be told outside efficiently.
<TXF FR=0003 HE=250 WI=080 LX=1100 LY=0300>[0004]this invention -- the above -- it accomplished in view of the Prior art and it is easy composition slimming down is easy a strong vibration is obtained and the transmission efficiency of vibration is also aimed at providing a good piezoelectric vibration device.
[0005]
[Means for Solving the Problem]A piezoelectric vibration device this invention is characterized by that comprises the following.
A piezoelectric transducer of a bimorph element which consists of a plate-like diaphragm and a piezo electric crystal stuck on the surface or a uni-morph element.
Resin or the metal cases where this piezoelectric transducer was accommodated.
Vibration transmitting members such as a support or a buck which one end connected with this piezoelectric transducer it was attached and the other end connected to the above-mentioned case.
The above-mentioned vibration transmitting member is the buck which held an edge part of the above-mentioned piezoelectric transducer and an end connected to the above-mentioned case. An oscillating successive diminution member which becomes the above-mentioned piezoelectric transducer from elastic members such as weight such as resin and metal or a metallic spring is attached.
[0006]This invention is the piezoelectric vibration device which provided the above-mentioned vibration transmitting member in a center section of the above-mentioned piezoelectric transducer and attached to an edge part of the above-mentioned piezoelectric transducer a buck which served as weight. A center section of the above-mentioned piezoelectric transducer is pinched by a support an elastic member and a support a support or an elastic member and elastic member.
[0007]
[Function]Since vibration is made to be transmitted to a case at the piezoelectric transducer in which the piezo electric crystal was stuck on the diaphragm via a support and a buck or an elastic member as for the piezoelectric vibration device of this invention vibration of a piezoelectric transducer is transmitted to a case efficiently and certainly. while vibration of

a piezoelectric transducer is changed into vibration of a desired low frequency wave amplitude is increased by the oscillating successive diminution member which consists of an elastic member or weight and a stronger vibration is transmitted to a case by it.
[0008]
[Example] The example of this invention is described based on a drawing below.
 Drawing 1 - drawing 7 show the first example of this invention and the piezoelectric vibration device 10 of this example is provided with the piezoelectric transducer 15 which is a bimorph element by which the piezo electric crystals 14 such as electrostrictive ceramics were stuck on the surface and rear surface of the metal diaphragms 12 as shown in drawing 1 . In the field of the outside of each piezo electric crystal 14 the electrode was formed and as for the electrode of another side the diaphragm 12 serves as while not illustrating. The buck 16 made of resin is formed in the edge part of the piezoelectric transducer 15 over the perimeter and this buck 16 is being fixed to the case 18.
[0009] As shown in drawing 2 the weight 20 which becomes a center section of the piezoelectric transducer 15 from an insulator or sheet metal such as resin is being fixed to this piezoelectric vibration device by adhesiveness such as an epoxy resin. This weight 20 amplifies the amplitude of vibration while decreasing successively the pitch in the simple substance of the piezoelectric transducer 15 to the low frequency wave of a request lower than a audio range for example 100-200 Hz. This weight 20 may be <DP N=0003><TXF FR=0001 HE=250 WI=080 LX=0200 LY=0300> directly fixed to the piezo electric crystal 14 of the piezoelectric transducer 15 via the spacers 22 such as resins as shown in drawing 3 . As shown in drawing 4 the weight 20 may be attached to the piezo electric crystal 14 of both sides of the piezoelectric transducer 15 via the spacer 22. As shown in drawing 5 without passing the spacer 22 the weight 20 may be directly fixed to the piezo electric crystal 14 of both sides of the piezoelectric transducer 15 and as shown in drawing 6 and drawing 7 the spacer 22 and the weights 20 such as resin formed in one may be fixed to both sides or one side of the piezoelectric transducer 15.
[0010] While supporting the piezoelectric transducer 15 which consists of bimorph elements by the support member 16 according to the piezoelectric vibration device of this example since the weight 20 was attached to the center section of the piezoelectric transducer 15 vibration of the piezoelectric transducer 15 is transmitted directly efficiently in the case 18 and it can be made a moreover very thin structure. While dropping pitch on desired frequency easily by having attached weight to the center section of the piezoelectric transducer 15 amplitude can be increased and vibration can be certainly transmitted to a user by strong vibration. As shown in drawing 5 it can slim down further by fixing the weight 20 to the piezoelectric transducer 15 directly.
[0011] The piezoelectric vibration device of the second example of this following invention is explained based on drawing 8 and drawing 9 . The member same here as an above-mentioned example attaches identical codes and omits explanation. The piezoelectric vibration device of this example connects the supports 24 such as resin in which the end was supported by the case 18 to the center section of the piezoelectric transducer 15. The piezoelectric vibration device 10 shown in drawing 8 connects the support 24 to both sides of the piezoelectric transducer 15 and the other end of the support 24 connects it to the case 18 respectively. And it is in the state where the buck 16 of the edge part of the piezoelectric transducer 15 was attached to the diaphragm 12 and it was located in midair and frequency successive diminution and an amplitude increase function are achieved as the weight 20. What is shown in drawing 9 formed the support 24 in one piezoelectric transducer 15 side and the buck 16 has connected it to the case 18 by the another side.
[0012] Since the piezoelectric vibration device of this example attached the support 24 to the center section of the piezoelectric transducer 15 vibration is transmitted with each certainly sufficient efficiency to the case 18. As shown in drawing 8 both sides of the case 18 can be vibrated in a similar manner by pinching and holding the piezoelectric transducer 15 with the support 24. As shown in drawing 9 one side of the case 18 can

be effectively vibrated by attaching the support 24 to one side of the piezoelectric transducer 15. [\[0013\]](#) The piezoelectric vibration device of the third example of this following invention is explained based on [JP-A-H07-213997.files/000012.gif](#) drawing 10 and [JP-A-H07-213997.files/000013.gif](#) drawing 11 and [JP-A-H07-213997.files/000014.gif](#) drawing 12. The member same here as an above-mentioned example attaches identical codes and omits explanation. The piezoelectric vibration device of this example is supported with the metallic springs 26 such as metal flat springs and a coil spring by using the center section of the piezoelectric transducer 15 as an elastic member as shown in [JP-A-H07-213997.files/000012.gif](#) drawing 10. The other end of the metallic spring 26 was [TXF FR=0002 HE=250 WI=080 LX=1100 LY=0300](#) connected to the case 18 and the buck 16 formed in the edge part of the piezoelectric transducer 15 is connected to the near case 18 of another side as a support member. As shown in [JP-A-H07-213997.files/000013.gif](#) drawing 11 the piezoelectric transducer 15 may be pinched in the case 18 with the supports 24 such as resin in which the end was supported and the metallic spring 26 it may hold in it and the buck 16 functions on it as the weight 20 in this case. As shown in [JP-A-H07-213997.files/000014.gif](#) drawing 12 the piezoelectric transducer 15 may be pinched with the metallic spring 26 of a couple and may be held. Also in this case the buck 16 is functioning as the weight 20. [\[0014\]](#) Since the piezoelectric vibration device of this example attached the metallic spring 26 to the center section of the piezoelectric transducer 15 while vibration is decreased successively efficiently amplitude increases effectively and a strong directly efficient vibration is transmitted to the case 18. By attaching the metallic spring 26 to one side of the piezoelectric transducer 15 as shown in [JP-A-H07-213997.files/000012.gif](#) drawing 10 one side of the case 18 -- effective -- oscillating **** -- as things are made and it is shown in [JP-A-H07-213997.files/000013.gif](#) drawing 11 vibration of the direction linked to the metallic spring 26 of the case 18 can be lessened by holding one piezoelectric transducer 15 side with the support 24 and supporting another side with the metallic spring 26. As shown in [JP-A-H07-213997.files/000014.gif](#) drawing 12 when both sides are supported with the metallic spring 26 both sides can be vibrated similarly. [\[0015\]](#) The piezoelectric vibration device of the fourth example of this following invention is explained based on [JP-A-H07-213997.files/000015.gif](#) drawing 13 and [JP-A-H07-213997.files/000016.gif](#) drawing 14. The member same here as an above-mentioned example attaches identical codes and omits explanation. The piezoelectric vibration device of this example supports one center-section side of the piezoelectric transducer 15 locates the piezoelectric transducer 15 in midair and operates the buck 16 as the weight 20. what is shown in [JP-A-H07-213997.files/000015.gif](#) drawing 13 supports the piezoelectric transducer 15 with the support 24 as a support member and a vibration transmitting member. what is shown in [JP-A-H07-213997.files/000016.gif](#) drawing 14 supports the piezoelectric transducer 15 with the metallic springs 26 such as metal flat springs and a coil spring as a support member a vibration transmitting member and an elastic member. [\[0016\]](#) Since the piezoelectric vibration device of this example connected the support 24 or the metallic spring 26 which the end connected to the case 18 to the center section of the piezoelectric transducer 15 vibration is efficient and vibration is transmitted to the case 18. The buck 16 of the edge part of the piezoelectric transducer 15 functions as the weight 20 while decreasing vibration of the piezoelectric transducer 15 successively efficiently amplitude is increased and vibration is directly transmitted to the case 18 efficiently. As shown in [JP-A-H07-213997.files/000015.gif](#) drawing 13 the near case 18 which the other end of the support 24 connected can be efficiently vibrated by connecting the support 24 to the center section of the piezoelectric transducer 15. As shown in [JP-A-H07-213997.files/000016.gif](#) drawing 14 the direction linked to the metallic spring 26 of the case 18 can be comparatively vibrated with big amplitude by a low frequency wave by supporting the support 24 only with the metallic spring 26. [\[0017\]](#) The piezoelectric vibration device of the fifth example of this following invention is [DP N=0004](#) [TXF FR=0001 HE=250 WI=080 LX=0200 LY=0300](#) explained based on [JP-A-H07-213997.files/000017.gif](#) drawing 15 and [JP-A-H07-213997.files/000018.gif](#) drawing 16. The member same here as an above-mentioned example attaches identical codes and omits explanation. The

piezoelectric vibration device of this example supports one near center section of the piezoelectric transducer 15 with the support 24 or the metallic spring 26 and supports it with the metallic springs 30 which connected the another side of the piezoelectric transducer 15 to the backing plate 28 fixed to the buck 16 and this backing plate 28 such as a flat spring and a coil spring. And the other end of the metallic spring 30 is connected to the case 18. What is shown in [drawing 15](JP-A-H07-213997.files/000017.gif) supports the center section of the piezoelectric transducer 15 with the support 24. What is shown in [drawing 16](JP-A-H07-213997.files/000018.gif) supports the center section of the piezoelectric transducer 15 with the metallic spring 26.

[0018] with the piezoelectric vibration device of this example as well as the third example of the above vibration can be effectively transmitted to the case 18.

[0019] The piezoelectric vibration device of the sixth example of this following invention is explained based on [drawing 17](JP-A-H07-213997.files/000019.gif). The member same here as an above-mentioned example attaches identical codes and omits explanation. The piezoelectric vibration device of this example forms the diaphragm 32 of the piezoelectric transducer 15 by insulating resin etc. And the metallic foil 34 is stuck on both sides of the diaphragm 32. And the piezoelectric vibration device of this example can also be used for the piezoelectric vibration device of the above-mentioned first thru/or the fifth example.

[0020] Since the piezoelectric vibration device of this example forms the diaphragm 32 with resin it can obtain big amplitude on lower frequency. The diaphragm 32 can also be formed in the buck 16 and one and insert molding of the metallic foil 34 can also be carried out in that case.

[0021] The piezoelectric vibration device of the seventh example of this following invention is explained based on [drawing 18](JP-A-H07-213997.files/000020.gif) and [drawing 19](JP-A-H07-213997.files/000021.gif) and [drawing 20](JP-A-H07-213997.files/000022.gif). The member same here as an above-mentioned example attaches identical codes and omits explanation. The piezoelectric vibration device of this example attaches the weight 20 to the buck 16 of the piezoelectric transducer 15 further at one. And the piezoelectric vibration device of this example can also be used for the piezoelectric vibration device of the above-mentioned first thru/or the fifth example.

[0022] The piezoelectric vibration device of this example can form the weight 20 in the buck 16 and one and can form it also by method such as 2 color shaping.

[0023] A uni-morph element may be sufficient as the piezoelectric transducer of the piezoelectric vibration device of this invention and it should just make a piezoelectric element produce field vibration. The elastic member of the piezoelectric vibration device of this invention is a thing that it may be a coil spring by metal resin product made of resin or metal besides a metallic spring and other springs or hard rubber of shape should just be the elastic members which cannot absorb vibration easily. The support itself may function as an elastic member slightly. And the construction material of a support may also be ceramics and metal besides resin.

[0024] [Effect of the Invention] The piezoelectric vibration device of this invention can [transmit vibration of a piezoelectric transducer to a case efficiently and moreover the strong vibration also with large amplitude is obtained. Therefore a user can detect a signal by vibration certainly.](JP-A-H07-213997.files/000003.gif)

DESCRIPTION OF DRAWINGS

SDO EDJ [TXF FR=0003 HE=230 WI=080 LX=1100 LY=0500](JP-A-H07-213997.files/000003.gif) [Brief Description of the Drawings]

[Drawing 1](JP-A-H07-213997.files/000003.gif) It is drawing of longitudinal section (A) and the top view (B) of a piezoelectric transducer of this invention. [of the first example]

[Drawing 2](JP-A-H07-213997.files/000004.gif) It is drawing of longitudinal section showing the piezoelectric vibration device of the first example of this invention.

[Drawing 3](JP-A-H07-213997.files/000005.gif) It is drawing of longitudinal section showing the modification of the piezoelectric vibration device of the first example of this invention.

[Drawing 4](JP-A-H07-213997.files/000006.gif) It is drawing of longitudinal section showing the modification of the piezoelectric vibration device of the first example of this invention.

[Drawing 5](JP-A-H07-213997.files/000007.gif) It is drawing of longitudinal section showing the modification of the piezoelectric vibration device of the first example of this invention.

[Drawing 6](JP-A-H07-213997.files/000008.gif) It is drawing of longitudinal section showing the modification of the piezoelectric vibration device of the first example of this invention.

[JP-A-H07-213997.files/000009.gif](#)>[Drawing 7]It is drawing of longitudinal section showing the modification of the piezoelectric vibration device of the first example of this invention.
<A [JP-A-H07-213997.files/000010.gif](#)>[Drawing 8]It is drawing of longitudinal section showing the piezoelectric vibration device of the second example of this invention.
<A [JP-A-H07-213997.files/000011.gif](#)>[Drawing 9]It is drawing of longitudinal section showing the modification of the piezoelectric vibration device of the second example of this invention.
<A [JP-A-H07-213997.files/000012.gif](#)>[Drawing 10]It is drawing of longitudinal section showing the piezoelectric vibration device of the third example of this invention.
<A [JP-A-H07-213997.files/000013.gif](#)>[Drawing 11]It is drawing of longitudinal section showing the modification of the piezoelectric vibration device of the third example of this invention.
<A [JP-A-H07-213997.files/000014.gif](#)>[Drawing 12]It is drawing of longitudinal section showing the modification of the piezoelectric vibration device of the third example of this invention.
<A [JP-A-H07-213997.files/000015.gif](#)>[Drawing 13]It is drawing of longitudinal section showing the piezoelectric vibration device of the fourth example of this invention.
<A [JP-A-H07-213997.files/000016.gif](#)>[Drawing 14]It is drawing of longitudinal section showing the modification of the piezoelectric vibration device of the fourth example of this invention.
<A [JP-A-H07-213997.files/000017.gif](#)>[Drawing 15]It is drawing of longitudinal section showing the piezoelectric vibration device of the fifth example of this invention.
<A [JP-A-H07-213997.files/000018.gif](#)>[Drawing 16]It is drawing of longitudinal section showing the modification of the piezoelectric vibration device of the fifth example of this invention.
<A [JP-A-H07-213997.files/000019.gif](#)>[Drawing 17]It is drawing of longitudinal section showing the piezoelectric vibration device of the sixth example of this invention.
<A [JP-A-H07-213997.files/000020.gif](#)>[Drawing 18]It is drawing of longitudinal section showing the piezoelectric vibration device of the seventh example of this invention.
<A [JP-A-H07-213997.files/000021.gif](#)>[Drawing 19]It is drawing of longitudinal section showing the modification of the piezoelectric vibration device of the seventh example of this invention.
<A [JP-A-H07-213997.files/000022.gif](#)>[Drawing 20]It is drawing of longitudinal section showing the modification of the piezoelectric vibration device of the seventh example of this invention.
[Description of Notations]
10 Piezoelectric vibration device
12 and 32 Diaphragm
14 Piezo electric crystal
15 Piezoelectric transducer
<DP N=0005><TXF FR=0001 HE=015 WI=080 LX=0200 LY=0300>16 Buck
18 Case
20 Weight
<TXF FR=0002 HE=010 WI=080 LX=1100 LY=0300>24 Support (support member)
2630 metallic springs (elastic member)
</SDO>
<HR></BODY></HTML>